U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Medical Electronics Engineering **Duration: 3 hrs.**

Course Code: 23MD5PCSGP / 22MD5PCSGP **Max Marks: 100**

Course: Signal Processing

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Discuss the classifications of signals with example.	CO1	PO1	**08**
	b)		Determine the energy of the signal $x(t)=\begin{cases} t & 0\le t\le 1 \\ 2-t & 1\le t\le 2 \\ 0 & otherwise \end{cases}$	CO1	PO1	**06**
	c)		Determine whether the following signals are periodic or not. If periodic find its fundamental period. i) $x(t)=\cos\left(\frac{\pi}{3}t\right)+\sin\left(\frac{\pi}{4}t\right)$ ii) $x(n)=\sin(2n)$	CO1	PO1	**06**
			OR			
2	a)		Discuss the properties of systems with example.	CO1	PO1	**08**
	b)		Evaluate the discrete time convolution sum y(n)=x(n)*h(n) where $x(n)=a^n u(n)$ and h(n)=u(n) for $0<a<1$.	CO1	PO1	**06**
	c)		Find the natural response for the system described by the following difference equation $y(n)-\frac{9}{16}y(n-2)=x(n-1)$ with y(-1)=1 and y(-2)=-1.	CO1	PO1	**06**
			UNIT - II			
3	a)		State and prove the following properties of discrete time Fourier series i) Time shift ii) Frequency shift	CO2	PO2	**06**
	b)		Obtain the frequency response of a discrete time LTI system with impulse response $h(n)=\left(\frac{1}{2}\right)^n u(n)$	CO2	PO2	**06**
	c)		Find the Fourier Transform of the signal $x(t)=e^{-at}u(t)$. Sketch Magnitude and Phase spectrum.	CO2	PO2	**08**

			OR			
	4	a)	Discuss the properties of ROC in Z-transform.	*CO2*	*PO2*	**06**
		b)	Determine Z-transform of $h(n) = -u(n-1) + \left(\frac{1}{2}\right)^n u(n)$. Draw its ROC.	*CO2*	*PO2*	**08**
		c)	A causal system has input x[n] and output y[n] as given below. Determine its impulse response. x[n]= δ[n] + $\frac{1}{4}$ δ[n-1] - $\frac{1}{8}$ δ [n-2] ; y[n]= δ[n] - $\frac{3}{4}$ δ[n-1]	*CO2*	*PO2*	**06**
			UNIT - III			
	5	a)	What is Sampling? Explain the process of reconstruction of signal in frequency domain.	*CO3*	*PO3*	**08**
		b)	Compute the 8-ponit DFT of the sequence x(n)={1,1,1,1}	*CO3*	*PO3*	**08**
		c)	The first 5 points of the eight-point DFT of a real valued sequence are (0.25, 0.125-j0.3018, 0, 0.125-j0.0518, 0). Determine the remaining three points.	*CO3*	*PO3*	**04**
			OR			
	6	a)	State and prove the following properties of DFT i) Circular Time Shift ii) Circular Convolution	*CO3*	*PO3*	**08**
		b)	Determine the circular convolution between x(n)=[2,1,2,1] and h(n)=[1,2,3,4].	*CO3*	*PO3*	**06**
		c)	Compute 4-point DFT of the sequence x(n)=[1,2,3,4]. Sketch magnitude and phase spectrum.	*CO3*	*PO3*	**06**
			UNIT - IV			
	7	a)	Find 4-point circular convolution of x(n)= {1,1,1,1} and h(n)= {1,0,1,0}. use DFT method.	*CO4*	*PO4*	**08**
		b)	A long sequence x(n) is filtered through a filter with impulse response h(n) to the output y(n). If x(n) = { 1,1,1,1,1,3,1,1,4,2,1,1,3,1}, h(n) = { 1,-1} Compute y(n) using the overlap save technique. Assume L=5.	*CO4*	*PO4*	**08**
		c)	Tabulate the number of complex multiplication and complex additions required for the direct computation of DFT and FFT algorithm for N = 16.	*CO4*	*PO4*	**04**
			OR			
	8	a)	Develop decimation in time FFT algorithm to compute DFT. Draw signal flow graph for N=8	*CO4*	*PO4*	**10**
		b)	Determine 8-point DFT of sequence x(n)= {1,1,0,0,-1,-1,0,0} using DIT-FFT method.	*CO4*	*PO4*	**10**

			UNIT - V			
	9	a)	Compare IIR and FIR filters.	*CO5*	*PO5*	**04**
		b)	If $Ha(s) = \frac{1}{(s+1)(s+2)}$, find the corresponding H(Z) using impulse invariance method. Assume T=0.1sec.	*CO5*	*PO5*	**06**
		c)	Design a Butterworth filter using the bilinear transformation for the following specifications $0.8 \le \left\|H(e^{j\omega})\right\| \le 1 \quad \text{for} \quad 0 \le \omega \le 0.2\pi$ $\left\|H(e^{j\omega})\right\| \le 0.2 \quad \text{for} \quad 0.6\pi \le \omega \le \pi$	*CO5*	*PO5*	**10**
			OR			
	10	a)	Name the types of windows used in the design of FIR filters. Write the analytical equations and draw the magnitude response characteristics of each window.	*CO5*	*PO5*	**10**
		b)	The desired frequency response of a lowpass filter is given by, $H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j2\omega}; \lvert w\rvert < \frac{\pi}{4} \\ 0; \frac{\pi}{4} < \lvert w\rvert < \pi \end{cases}$ Determine the frequency response of the FIR filter if rectangular window is used for N=5.	*CO5*	*PO5*	**10**

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